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Non-routine Discharge Disposition is Associated with Post-discharge Complications and 30-day Readmissions Following Craniotomy for Brain Tumor Resection

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Abstract

Several studies have reported an association between high-volume brain tumor centers and greater rates of routine discharge disposition in the context of better outcomes. However, the relationship between in-hospital complications, discharge destination, and postoperative adverse events (AEs) remains unexplored. The purpose of this study was thus to use a large, prospectively collected database to examine the association between discharge destination, post-discharge complications, readmissions, and reoperations among patients undergoing craniotomy for brain tumor. The 2011–2014 National Surgical Quality Improvement (NSQIP) database was employed to identify all adult patients who underwent a craniotomy for brain tumor resection. Demographics, comorbidities, and perioperative variables were collected for each patient. Univariate statistics with subsequent binary logistic regression analyses were used to explore the relationship between these perioperative factors and postoperative events, including major post-discharge complications, minor post-discharge AEs, readmissions, and return to the operating room (ROR). Significant variables such as demographics, comorbidities, operative time, body mass index, ASA classification and pre-discharge complications were controlled for in each model. Of the 14,854 patients identified, 11,409 (77.9%) were discharged home. After controlling for comorbidities and in-hospital AEs, discharge to skilled rehabilitation was an independent predictor of major post-discharge complications (OR: 1.74, 95%CI: 1.31–2.30, $p<0.001$), minor post-discharge events (OR: 1.60, 95%CI: 1.07–2.41, $p=0.024$), and ROR (OR: 1.68, 95%CI: 1.27–2.22, $p<0.001$). Discharge to a care facility was predictive of major complications (OR: 1.51, 95%CI: 1.04–2.19, $p=0.030$) and ROR (OR: 2.02, 95%CI: 1.46–2.80, $p<0.001$). These factors may be considered in discharge planning and further outcomes studies for patients undergoing resection.

Keywords

Discharge destination; NSQIP; readmissions; adverse events; morbidity

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INTRODUCTION

Surgical resection via craniotomy is the standard of care in the treatment of many types of intracranial tumors. However, there is a well-documented risk of transient and permanent neurological deficits as well as other complications following these procedures [1–7]. Certain patients undergoing craniotomy for tumor resection may benefit from closer surveillance and trained assistance during recovery, and as such over 20% of these patients are discharged to skilled nursing facilities (SNF) or inpatient rehabilitation facilities (IRF) [1, 8]. However, recent studies evaluating the influence of discharge disposition on postoperative outcomes following various surgical procedures have questioned the positive impact of these centers, particularly in the context of potentially increased risk for post-discharge complications and the high costs associated with therapy [9–11]. In a cohort of brain tumor patients undergoing resection, the median total hospitalization costs were reported to be over 40% higher for patients discharged to a care facility when compared to those who were discharged home [12]. As such, identification of the perioperative risk factors predictive of non-home discharge disposition may facilitate informed disposition selection and more effective perioperative resource utilization.

Despite several studies reporting an association between in-hospital complications, discharge destination, and post-discharge outcomes in other surgical cohorts [10, 13], these relationships remain relatively unexplored in neurosurgical oncology. Prior studies have highlighted a significant association between higher volume brain tumor centers/providers and greater rates of routine discharge as well as superior outcomes, but the impact of disposition selection on outcomes is not well-established [1, 14, 15]. We hypothesized that non-home discharge disposition is a significant, independent risk factor for post-discharge adverse events. As such, the purpose of this study was to utilize a large, prospectively collected database in order to examine the association between discharge destination, post-discharge complications, readmissions, and return to the operating room among patients undergoing craniotomy for brain tumor.

METHODS

Data were collected from the 2011–2014 National Surgical Quality Improvement (NSQIP) database. This registry provided a logistically attractive framework via which to test our hypothesis. First, a wide array of variables, including many preoperative comorbidities, laboratory values, and readmission/length of stay (LOS) are manually extracted by dedicated NSQIP coordinators and can be controlled for in the predictive models. The detailed data regarding timing can be utilized to stratify adverse events relative to discharge. Second, the dataset undergoes robust oversight and assessment to ensure data integrity [16].

All adult patients undergoing craniotomy for brain tumor were identified using Current Procedural Terminology (CPT) and International Classification of Diseases (ICD)-9 coding as per prior NSQIP analyses of this patient population [8]. Inclusion criteria consisted of: 1) adult patients over the age of 18, 2) patients who underwent a craniotomy or craniectomy for tumor excision, as characterized by CPT codes (61500, 61510, 61512, 61518, 61519, 61520,

61521, 61526, or 61530), and 3) a postoperative ICD-9 diagnosis describing a primary brain tumor, secondary brain tumor, tumor of the meninges, or cranial nerve tumor.

Demographic variables, including age, sex, race, and body mass index (BMI) as well as any preoperative comorbidities were recorded for each patient. Comorbidity variables included diabetes, cigarette use, functional dependency, ventilator use, chronic obstructive pulmonary disease (COPD), hypertension, ascites, congestive heart failure (CHF), myocardial infarction (MI), dyspnea, peripheral vascular disease (PVD), transient ischemic attack (TIA), cerebrovascular accident (CVA), history of renal failure, percutaneous coronary intervention (PCI), bleeding disorder, rapid weight loss, prior transfusion, steroid use, dialysis, and sepsis. Perioperative factors included American Society of Anesthesiologists (ASA) score, operative time, and total hospital LOS. Previously described CPT and ICD-9 coding was employed to stratify patients by procedure type (supratentorial or infratentorial craniotomy) as well as by histologic diagnosis (primary brain, secondary brain, meninges, or cranial nerve tumor) [8].

Preoperative laboratory values were extracted for each patient, and classified as normal or abnormal based on institutional ranges. These included sodium (normal: 135–145 mEq/L), blood urea nitrogen (BUN) (normal: 7–20 mg/dL), creatinine (normal: 0.5–1.2 mg/dL), albumin (3.4–5.4 g/dL), bilirubin (normal: 0.3–1.9 mg/dL), serum glutamic oxaloacetic transaminase (SGOT) (10–34 IU/L), alkaline phosphatase (44–147 IU/L), white blood cell count (WBC) (4.5–10k/mcL), hematocrit (38–54%), and platelet count (150–400k/mcL).

Postoperative events, including discharge destination (home, skilled rehabilitation, or care facility) as well as 30-day readmissions were recorded. Postoperative complications, which are recorded in the registry within 30 days following surgery, were sub-divided into pre- and post-discharge adverse events based on the timing of the occurrence. The main outcome variables in our analysis included post-discharge major complications, post-discharge minor complications, readmissions, and return to the operating room (OR) within 30 days. Major and minor complications were classified as per prior NSQIP studies in the literature [17]. Major complications included prolonged ventilator use of 48 hours or more, unplanned reintubation, sepsis, septic shock, coma, stroke, cardiac arrest, myocardial infarction (MI), venous thromboembolism, infection of the surgical site or organ space, and acute renal failure. Perioperative blood transfusion, pneumonia, urinary tract infection (UTI), wound dehiscence, and renal insufficiency were classified as minor complications.

Statistical Analysis

Univariate calculations were performed to report the mean and standard deviation (SD) of continuous variables along with the number and proportion of the total for categorical variables. Bivariate analyses were then performed to test the perioperative variables for association with non-home discharge. Variables resulting in $P < 0.1$ were subsequently incorporated into a multivariable, binary logistic regression model in order to identify significant predictors of non-routine discharge disposition. These analyses were then replicated to identify independent predictors of major post-discharge complications, minor post-discharge complications, readmissions, and return to the operating room in order to explore the relationship between discharge destination and subsequent adverse events.

Separate models were constructed to assess potential risks associated with discharge to skilled rehabilitation or care facility as compared to home discharge. The area under the receiver operating characteristic curve (AUC) was computed to assess the predictive capacity of each model and the Hosmer-Lemeshow test was performed to test for lack of goodness-of-fit to the data. All statistical analyses were performed using IBM SPSS Statistics 22 (IBM, Armonk, NY).

RESULTS

Case Series Characteristics

A total of 14,854 patients were included in our study. In this cohort, the mean age was 56 (± 15) years, the mean BMI was 28 (± 8), and 7,024 (47.3%) of patients were male. The most prevalent comorbidities were hypertension, present in 38.6% of patients, followed by cigarette use in 19.4% of patients. The majority (80.4%) of the tumors were classified as supratentorial. The mean operative time was 214 (± 134) minutes and the mean hospital LOS was 7 (± 8) days. At discharge, 77.9% of patients were discharged home. These case series characteristics are outlined in Table 1.

The mortality rate in our series was 3.3%. Prior to discharge, 4.7% of patients experienced a major complication and 6.7% experienced a minor complication. The most common pre-discharge complications were perioperative transfusion (4.8%), ventilator use for more than 48 hours (2.2%), and unplanned intubation (1.6%). Following discharge, 4.8% of patients experienced a major complication and 1.7% had a minor complication. The most frequent post-discharge complications were DVT (1.4%), UTI (1.0%), and PE (1.0%). The full breakdown depicting the incidence and timing of these complications can be found in Table 2.

The variables resulting in $P < 0.1$ via bivariate analyses are reported in Table 3. These factors were then incorporated into the corresponding multivariable regressions for each outcome of interest. There were 8 independent predictors of non-home discharge in the multivariable model. The two modifiable risk factors included hypertension (OR: 1.21, 95%CI: 1.06–1.39, $p = 0.005$) and BMI (OR: 1.01, 95%CI: 1.00–1.02, $p = 0.039$). Preoperative characteristics, including dependent functional status (OR: 2.54, 95%CI: 2.03–3.18, $p < 0.001$), age (OR: 1.035, 95%CI: 1.03–1.04, $p < 0.001$), and ASA score ($p < 0.001$) were also significantly predictive. In addition, pre-discharge complications of stroke (OR: 5.95, 95%CI: 3.06–11.58, $p < 0.001$) and transfusion (OR: 1.48, 95%CI: 1.14–1.19, $p = 0.003$) were significantly associated with non-home discharge. Finally, perioperative predictors included operative time (OR: 1.001, 95%CI: 1.001–1.002, $p < 0.001$) and total hospital stay (OR: 1.12, 95%CI: 1.11–1.14, $p < 0.001$). The computed AUC for the model was 0.81. These findings are presented in Table 4.

After controlling for significant comorbidities, perioperative variables, and in-hospital adverse events, discharge to skilled rehabilitation remained an independent predictor of major post-discharge complications (OR: 1.74, 95%CI: 1.31–2.30, $p < 0.001$), minor post-discharge events (OR: 1.60, 95%CI: 1.07–2.41, $p = 0.024$), and return to the operating room (OR: 1.68, 95%CI: 1.27–2.22, $p < 0.001$). Discharge to a care facility was predictive of major

complications (OR: 1.51, 95%CI: 1.04–2.19, $p=0.030$) and return to the operating room (OR: 2.02, 95%CI: 1.46–2.80, $p<0.001$). The associations between discharge disposition and these post-discharge adverse outcomes, along with the corresponding AUCs of the models, can be found in Table 5. There was no lack of goodness-of-fit to the data.

DISCUSSION

Several studies have reported that patients undergoing craniotomy for brain tumor resection at high-volume centers experience both significantly fewer complications and reduced rates of non-routine discharge disposition [1, 14]. However, the direct relationship between discharge disposition and postoperative outcomes was not assessed in their analyses. In addition, although approximately 22% of brain tumor patients are discharged to a care facility following resection, the predictors of non-routine discharge have not been adequately addressed [8, 15]. In this analysis, we identified the specific perioperative variables and pre-discharge complications that were risk factors for non-home discharge. These data also demonstrated significant associations between discharge to skilled rehabilitation or care facilities and post-discharge adverse outcomes, such as major complications and return to the operating room, when controlling for other significant factors.

Determining a patient's discharge disposition is one of the major decisions that must be made in the postoperative period [11]. When deemed necessary, the logistics of arranging and facilitating the transfer of a patient to a care facility can lead to delays and unnecessarily extend a patient's hospital stay [9, 18, 19]. Taking proactive steps for patients at higher risk for non-routine discharge disposition has been proposed as a means of streamlining the discharge process [19]. As such, investigators in a variety of surgical subspecialties have sought to develop instruments to predict which patients may be at increased risk for non-routine discharge [9, 20, 21]. These tools range from simple calculators designed to be used for a wide array of patients [20] to instruments developed for individual procedures, such as primary total joint arthroplasty [21–23]. Identification of the characteristics and perioperative events associated with non-home discharge in specific patient populations can facilitate more effective risk assessment and management [10]. Our model, which incorporated patient demographics and comorbidities, preoperative laboratory lab values, pre-discharge complications, and other perioperative variables, provided strong discriminatory capacity (AUC=0.81). These findings may have utility in the development of readmission risk assessment tools for patients undergoing brain tumor resection.

Although a full analysis of the risks for non-routine discharge disposition following craniotomy for tumor resection has not been performed in the literature, several pertinent factors have been identified as part of studies investigating other clinical phenomena. Trinh et al.'s evaluation of the effect of surgeon and hospital brain tumor case volume on outcomes revealed that, as in our study, traits like older age and higher comorbidity burden decrease the likelihood of routine discharge [15]. However, their analysis, which focused primarily on institutional factors, included a limited number of patient and operative characteristics as covariates and only recorded comorbidities as part of a cumulative score. Additionally, Dasenbrock et al. utilized the NSQIP database to examine drivers of hospital LOS following craniotomy for tumor [8]. They found that greater LOS was significantly associated with

non-routine discharge, a conclusion that is corroborated by our results. Several of our other findings are supported by similar studies performed for different surgical populations. For instance, age, hypertension, and operative complications, which were identified as predictors of non-home discharge in our study, were significantly associated with discharge destination in a cohort of patients undergoing spinal fusion [24]. Hypertension is a modifiable risk factor, and has been shown to be significantly associated with adverse post-operative events [25, 26]. Adequate preoperative management via a medication regimen may provide some benefit to these patients.

The relationship between discharge disposition and subsequent outcomes is fairly unexplored, particularly in the neurosurgery literature [10, 13, 27]. A recent analysis of hospital readmissions following brain tumor resection included discharge destination as possible driver, although this relationship did not reach statistical significance upon multivariable analysis [27]. The most comprehensive study of this nature was performed by Keswani et al., who utilized the 2011–2013 NSQIP database to collect data on patients undergoing joint replacement [10]. The authors found that non-routine discharge was significantly associated with unplanned 30-day readmission and severe adverse events. These results corroborate aspects of our findings, where patients discharged to rehabilitation or care facilities experienced greater incidence of major complications, minor complications, and return to the operating room. A variety of factors may contribute to these findings. For one, there are inherent risks to undergoing therapy at these types of facilities that are similar to those associated with inpatient settings. Pathogens like Methicillin-resistant *Staphylococcus aureus* (MRSA) can be found in skilled care facilities, and the increased risk of exposure may lead to complications requiring hospital readmission [28, 29]. In addition, substantial heterogeneity in both the quality of care and adherence to established protocols has been identified. A report by the Department of Health and Human Services reviewing a sample of SNF stays, for instance, found significant variability in the establishment of appropriate care, wound treatment, and patient discharge plans [30]. Other studies have assessed the reimbursement mechanisms surrounding SNF stays, which are currently not linked to outcome metrics like hospital readmission [10, 31]. However, it is clear that there is a subset of patients who simply cannot be discharged to home following resection. As such, these factors may be considered on a case-by-case basis in patient counseling and discharge planning. Further studies are needed to elucidate the relationship between discharge disposition and the development of adverse events leading to readmission.

These findings must be assessed in the context of limitations in study design. Although the registry data are collected prospectively, this represents a retrospective analysis and is thus at inherent risk for selection bias. Additionally, there are variables that are not recorded in the NSQIP database and thus could not be used in our analysis. First, provider and hospital volume have been shown to be associated with discharge disposition, but could not be examined in the present study. Second, variables specific to neurosurgical oncology, such as biomarker data and tumor recurrence are not collected. Third, socioeconomic variables including family support could not be assessed. As such, it was not possible to determine the rationale behind decisions regarding discharge destination for each patient. Finally, adverse events are only tracked within the first 30-day window, precluding the examination of the relationship between discharge disposition and long-term postoperative outcomes.

CONCLUSION

A number of patient characteristics and perioperative factors were shown to be predictive of discharge disposition in this study. Non-routine discharge was significantly associated with an array of complications as well as return to the operating room following hospital discharge. These factors may be considered in discharge planning and further outcomes studies for patients undergoing resection.

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Table 1

Case Series Characteristics

<i>Demographics</i>	N=14,854
Age (mean +/- SD)	56 ± 15 years
BMI (mean +/- SD)	28 ± 8
Sex (M: F)	7,024: 7,827
Functionally dependent	723 (4.9%)
<i>Select Comorbidities</i>	
Hypertension	5,739 (38.6%)
Cigarette use	2,887 (19.4%)
Preoperative steroid use	2,420 (16.3%)
Diabetes	1,689 (11.4%)
<i>Tumor Histology</i>	
Primary brain tumor - benign	599 (4.1%)
Primary brain tumor - malignant	5,314 (36.7%)
Primary brain tumor - unknown malignancy	1242 (8.6%)
Secondary brain or extracranial tumor	3,100 (21.4%)
Meninges tumor - benign	3,262 (22.5%)
Meninges tumor - malignant	120 (0.8%)
Cranial nerve - benign	549 (3.8%)
Cranial nerve - malignant	37 (0.2%)
<i>Tumor Location</i>	
Supratentorial	11,946 (80.4%)
Infratentorial	2,908 (19.6%)
<i>Perioperative Variables</i>	
Operative time (mean +/- SD)	214 ± 134 min
Hospital length of stay	7 ± 8 days
ASA score 1–2	4,149 (27.9%)
ASA score 3	8,735 (58.8%)
ASA score 4–5	1,829 (12.3%)
Readmitted to hospital	1,449 (9.8%)
Died	483 (3.3%)
<i>Discharge Destination</i>	
Home	11,409 (77.9%)
Skilled rehabilitation	2,048 (14.0%)
Care facility	1,187 (8.1%)

ASA: American Society of Anesthesiologists

BMI: Body Mass Index

Table 2**Incidence of the Most Common Postoperative Complications**

<i>Before Discharge</i>	
<i>Major Complications</i>	705 (4.7%)
Ventilator (>48 hours)	320 (2.2%)
Unplanned intubation	236 (1.6%)
Stroke	146 (1.0%)
DVT	128 (0.9%)
<i>Minor Complications</i>	998 (6.7%)
Perioperative transfusion	712 (4.8%)
UTI	182 (1.2%)
Pneumonia	181 (1.2%)
<i>After Discharge</i>	
<i>Major Complications</i>	712 (4.8%)
DVT	214 (1.4%)
PE	144 (1.0%)
Organ space infection	110 (0.7%)
Sepsis	108 (0.7%)
<i>Minor Complications</i>	258 (1.7%)
UTI	153 (1.0%)
Pneumonia	81 (0.5%)

DVT: Deep vein thrombosis

PE: Pulmonary embolism

UTI: Urinary tract infection

Table 3

Variables Resulting in P<0.1 via Bivariate Analysis With Outcome Metrics of Interest

Non-home Discharge	OR (95% CI)
Age	1.041 (1.038–1.044)
BMI	0.997 (0.993–1.002)
Male sex	1.02 (0.95–1.10)
Diabetes	2.17 (1.94–2.42)
Cigarette use	0.89 (0.81–0.99)
Dyspnea	1.35 (1.14–1.61)
Dependent functional status	4.56 (3.90–5.34)
COPD	1.45 (1.22–1.72)
Hypertension	2.03 (1.87–2.19)
Renal failure	8.84 (2.77–28.21)
Dialysis	2.75 (1.37–5.54)
Steroid use	1.13 (1.02–1.25)
Weight loss	1.86 (1.48–2.34)
Bleeding disorder	2.21 (1.75–2.78)
Superficial SSI before discharge	4.55 (1.69–12.21)
Organ space SSI before discharge	5.15 (2.39–11.11)
PE before discharge	4.68 (2.69–8.16)
Progressive renal insufficiency before discharge	3.53 (0.88–14.12)
Acute renal failure before discharge	1.001 (1.000–1.002)
UTI before discharge	7.54 (5.48–10.37)
Stroke before discharge	16.45 (10.45–25.88)
Cardiac arrest before discharge	3.93 (1.60–9.68)
MI before discharge	5.30 (1.89–14.91)
Bleeding transfusion before discharge	2.81 (2.40–3.29)
DVT before discharge	8.74 (5.82–13.14)
Sepsis before discharge	8.00 (5.03–12.72)
Septic shock before discharge	21.32 (7.39–61.48)
Pneumonia before discharge	11.44 (7.81–16.77)
Abnormal sodium	1.55 (1.38–1.75)
Abnormal BUN	1.75 (1.61–1.91)
Abnormal creatinine	1.65 (1.45–1.88)
Abnormal albumin	2.13 (1.85–2.44)
Abnormal WBC	1.23 (1.13–1.33)
Abnormal hematocrit	1.54 (1.41–1.67)
Operation time	1.001 (1.001–1.001)
Total hospital stay	1.15 (1.14–1.16)

Non-home Discharge		OR (95% CI)	
ASA Score ^Y		N/A	
Major Post-discharge Complications	OR (95%CI) ⁶	Minor Post-discharge Complications	OR (95%CI)
Age	1.011 (1.005–1.016)	Age	1.03 (1.02–1.04)
BMI	1.02 (1.01–1.03)	BMI	1.01 (1.00–1.03)
Male sex	1.28 (1.10–1.49)	Male sex	1.00 (0.781–1.28)
Cigarette use	0.80 (0.65–0.98)	Diabetes	1.90 (1.39–2.60)
Dyspnea	1.53 (1.14–2.07)	Dyspnea	2.02 (1.31–3.12)
Dependent functional status	1.49 (1.10–2.01)	Dependent functional status	2.56 (1.72–3.79)
COPD	1.67 (1.25–2.24)	COPD	2.78 (1.89–4.11)
Ascites	7.95 (1.54–41.07)	Renal failure	15.58 (4.32–56.2)
Hypertension	1.27 (1.09–1.48)	Hypertension	2.03 (1.59–2.60)
Steroid use	1.58 (1.32–1.89)	Steroid use	1.83 (1.38–2.42)
Bleeding disorder	1.78 (1.18–2.67)	Weight loss	2.45 (1.41–4.24)
Abnormal sodium	1.32 (1.05–1.66)	Abnormal sodium	1.63 (1.15–2.29)
Abnormal BUN	1.49 (1.26–1.75)	Abnormal BUN	1.65 (1.27–2.13)
Abnormal albumin	1.08 (0.82–1.43)	Abnormal albumin	1.47 (0.98–2.20)
Abnormal WBC	1.30 (1.12–1.52)	Abnormal WBC	1.60 (1.25–2.05)
Bleeding transfusion before discharge	1.57 (1.17–2.11)	Abnormal hematocrit	1.42 (1.09–1.84)
Operation time	1.000 (1.000–1.001)	Abnormal platelet count	2.07 (1.51–2.83)
Total hospital stay	0.998 (0.988–1.008)	UTI before discharge	0.988 (0.986–0.989)
ASA Score	N/A	Stroke before discharge	2.46 (1.07–5.61)
		Bleeding transfusion before discharge	1.50 (0.92–2.44)
		DVT before discharge	4.39 (2.21–8.75)
		Operation time	1.000 (0.999–1.001)
		Total hospital stay	1.01 (1.00–1.03)
		ASA Score	N/A
Readmission	OR (95%CI)	Return to OR	OR (95%CI)
Age	1.004 (1.000–1.008)	BMI	
BMI	1.015 (1.008–1.022)	Male sex	1.26 (1.09–1.46)
Male sex	1.25 (1.12–.39)	Dyspnea	
Diabetes	1.22 (1.04–1.44)	Dependent functional status	1.95 (1.50–2.53)
Dependent functional status	1.53 (1.23–1.90)	Hypertension	1.33 (1.15–1.54)
COPD	1.27 (1.00–1.61)	Steroid use	1.29 (1.08–1.55)
Ascites	6.90 (1.54–30.86)	Weight loss	1.56 (1.04–2.32)
CHF	2.60 (1.24–5.44)	Bleeding disorder	1.77 (1.19–2.62)
Renal failure		Abnormal sodium	1.33 (1.07–1.65)
Hypertension	1.34 (1.20–1.49)	Abnormal BUN	1.17 (0.99–1.37)
Steroid use	1.39 (1.21–1.59)	Abnormal albumin	1.34 (1.04–1.74)
Bleeding disorder	1.80 (1.33–2.44)	Abnormal WBC	1.36 (1.17–1.57)

Non-home Discharge		OR (95% CI)	
Prior transfusion	2.31 (1.22–4.35)	Abnormal platelet count	1.22 (0.98–1.52)
Abnormal sodium	1.31 (1.11–1.54)	Superficial SSI before discharge	8.40 (2.90–24.23)
Abnormal BUN	1.24 (1.10–1.39)	Deep SSI before discharge	64.86 (13.45–312.76)
Abnormal creatinine	1.33 (1.11–1.59)	Organ space SSI before discharge	28.19 (13.53–58.73)
Abnormal albumin	1.19 (0.98–1.45)	Dehiscence before discharge	27.65 (4.61–165.74)
Abnormal WBC	1.18 (1.06–1.32)	Pneumonia before discharge	5.08 (3.53–7.33)
Abnormal platelet count	1.33 (1.13–1.56)	Intubation before discharge	10.40 (7.86–13.76)
Pneumonia before discharge	0.54 (0.28–1.02)	PE before discharge	5.33 (2.93–9.69)
Intubation before discharge	1.43 (0.97–2.09)	Progressive renal insufficiency before discharge	4.58 (0.97–21.58)
Ventilator before discharge	87.33 (26.52–287.62)	UTI before discharge	3.28 (2.17–4.97)
Progressive renal insufficiency before discharge	6.14 (1.73–21.77)	Stroke before discharge	6.50 (4.44–9.51)
Coma before discharge	6.13 (1.02–36.69)	Coma before discharge	12.27 (2.05–73.56)
Cardiac arrest before discharge	2.30 (0.86–6.14)	Cardiac arrest before discharge	4.62 (1.73–12.33)
Bleeding transfusion before discharge	1.29 (1.02–1.63)	MI before discharge	6.15 (1.98–19.11)
ASA Score	N/A	Bleeding transfusion before discharge	2.60 (2.04–3.31)
		DVT before discharge	7.49 (5.06–11.09)
		Sepsis before discharge	6.09 (3.74–9.90)
		Septic shock before discharge	5.38 (2.74–10.57)
		Ventilator before discharge	9.3 (7.25–11.94)
		Operation time	1.002 (1.002–1.002)
		Total hospital stay	1.06 (1.05–1.07)
		ASA Score	N/A

^ψ ASA Score was assessed as part of a 4×2 table and the OR could thus not be computed

ASA: American Society of Anesthesiologists

BMI: Body Mass Index

BUN: Blood urea nitrogen

CHF: Congestive heart failure

COPD: Chronic obstructive pulmonary disease

DVT: Deep vein thrombosis

PE: Pulmonary embolism

SSI: Surgical site infection

UTI: Urinary tract infection

WBC: White blood cell count

Table 4

Significant Predictors of Non-home Discharge Disposition (AUC=0.81)

<i>Perioperative Risk Factor</i>	<i>Odds Ratio</i>	<i>95% Confidence Interval</i>	<i>P</i>
Dependent functional status	2.54	2.03–3.18	<0.001
Hypertension	1.21	1.06–1.39	0.005
Stroke before discharge	5.95	3.06–11.58	<0.001
Transfusion before discharge	1.48	1.14–1.91	0.003
Age	1.035	1.03–1.04	<0.001
BMI	1.01	1.00–1.02	0.039
ASA Score	-	-	<0.001
Operation time	1.001	1.001–1.002	<0.001
Hospital length of stay	1.12	1.11–1.14	<0.001

ASA: American Society of Anesthesiologists

BMI: Body Mass Index

Table 5

Discharge Disposition as a Predictor of Post-discharge Complications

<i>Outcome Variable</i>	<i>Odds Ratio</i>	<i>95% Confidence Interval</i>	P	AUC
<i>Major Complication</i>				
Skilled rehabilitation ^Ψ	1.74	1.31–2.30	<0.001	0.604
Care facility ^Ψ	1.51	1.04–2.19	0.030	0.607
<i>Minor Complication</i>				
Skilled rehabilitation	1.60	1.07–2.41	0.024	0.713
Care facility	-	-	-	-
<i>Readmission</i>				
Skilled rehabilitation	-	-	-	-
Care facility	-	-	-	-
<i>Return to OR</i>				
Skilled rehabilitation	1.68	1.27–2.22	<0.001	0.688
Care facility	2.02	1.46–2.80	<0.001	0.680

^Ψ Compared to home discharge

AUC: Area under the curve